THE USE OF SMALL CYLINDRICAL SAMPLERS FOR ESTIMATING THE WEIGHT OF FOREST LITTER*

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The use of a small cylindrical sampler with a cross-sectional area of 1 cm^2 enables samples of forest litter and the underlying humus layers to be taken quickly and with very little disturbance of the habitat. The results show a surprisingly low degree of scatter considering the small weight of litter removed, and agree well with estimates based on much larger samples. Although month-to-month inconsistencies were encountered when attempts were made to follow the changes in weight of litter after leaf fall, these inconsistencies are equally liable to occur with samplers of larger size.

As an adjunct to studies on the nematodes of forest litter it was desirable to know the weight of litter per unit area of forest floor and, if possible, to follow the progressive disappearance of the material after leaf fall. However, as the experimental plots were small, the well-tried method of hand-picking litter from within a frame of known area (e.g. 0·25 m^2) was considered unsuitable. Instead, small metal cylindrical samplers, as used in soil faunal studies by HAARLØV and WEIS-FOGH (1954), OVERGAARD (1948), and MINDERMAN (1957: see also Vol. 2), were tried‡.

The experimental plots (plots 1 and 2: 15 × 30 m and 4 × 8 m respectively) were situated in Roudsea Wood Nature Reserve, North Lancashire, in a mature oak-wood (mainly *Quercus petraea* Liebl.) growing on a thin acid soil (A_1 horizon, pH 3·5–3·7) overlying Silurian slate. The ground vegetation consisted of a sward of *Deschampsia flexuosa* (L.) and *Agrostis tenuis* Sibth. with occasional *Lonicera periclymenum* L., *Teucrium scorodonia* L. and *Rubus fruticosus* L. agg.; the humus was a moder-type mor (KUBIËNA, 1953). The results, which are detailed below, showed unequivocally the advantages of small samplers in economy of material, speed of sampling and ease of working.

METHOD

In order to achieve a compromise between the scatter of weights of individual cores and the disturbance of the habitat caused by sampling, a range of core sizes was tested in plot 1 shortly after leaf fall. The areas of the samplers used were 1·0, 2·63, 8·5 and 41·5 cm^2 respectively, the smallest one having a

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‡ Von Törne (p. 240) describes a novel cylindrical sampler for use in manure and compost heaps—Ed.

1-mm rebate, 4 mm behind the cutting edge. With the two smaller sizes it was possible to cut through the litter cleanly and easily, whereas the 8·5-cm² sampler tended to give ragged-edged samples, especially when the cutting edge became blunt. The 41·5-cm² instrument, even with a sharp cutting

Table 70. Comparison of cylindrical samplers of different sizes for leaf litter (mean oven-dry weight ± S.E.; 20 sampling units per method)

Sampling-unit area (cm²)	Litter		Standard error (per cent)
	Total weight (g)	Mean weight (g/m²)	
1	0·53	265 ± 32·5	12·3
2·63	1·3	246 ± 27·5	11·2
8·5	3·8	223 ± 25·0	11·2
41·5	18·9	227 ± 20·0	8·8

edge, would not cut the litter, which had to be removed by hand after cutting around the sampler's inner edge with a scalpel. Litter cores obtained with the three smaller samplers were pushed upwards through the sampling tube with a ramrod. The individual sampling units were examined in the field and all pieces of recently fallen oak-leaf lamina were transferred to a tube with a fine forceps. The remaining material including oak petioles was discarded. The selected litter was dried to constant weight at 105°C and subsequently weighed to the nearest 0·1 mg (*Table 70*).

RESULTS

On the basis of the means and their standard errors the estimates of litter per unit area are not significantly different, although there is an expected decrease in scatter with increasing sampler size. It is noteworthy that,

Table 71. Comparison of 1-cm² and 2·63-cm² cylindrical samplers for leaf litter (mean oven-dry weight ± S.E.; 50 sampling units per method)

Sampling-unit area (cm²)	Litter mean weight (g/m²)	Standard error (per cent)
1	246·4 ± 18·0	7·3
2·63	225·7 ± 22·0	9·7

although the largest sampler caused over forty times more disturbance to the habitat than did the smallest one, the standard error has been reduced by less than one third. As the samplers with areas of 1 cm² and 2·63 cm² were the only suitable ones for routine use, they were compared in greater detail, using 50 random sampling units from plot 1 in each case. No significant differences were shown in the performances of the two samplers (*Table 71*).

A comparison of the variances of litter weight per unit area gave $F = 1{\cdot}42$ ($P \simeq 0{\cdot}26$; Snedecor's F test) while comparison of the mean weights gave $t = 0{\cdot}721$ ($P \simeq 0{\cdot}47$).

On an adjacent area (plot 2), the performance of the 1-cm² sampler was compared with hand-picking from within a frame (A 0·25 m²). The estimates of freshly fallen litter are similar (*Table 72*) and the mean of the

Table 72. Comparison of 1-cm² cylindrical sampler and hand-picking for sampling leaf litter
(mean oven-dry weight ± S.E.; plot 2)

Method	Sampling-unit area (cm²)	Number of sampling units	Litter		Standard error (per cent)
			Total weight (g)	Mean weight (g/m²)	
Cylindrical sampler	1	50	0·68	136·5	—
Hand-picking	2,500	10	372·5	149·0 ± 9·3	6·2

sampler data is well within the 95 per cent confidence limits of the frame data. A more rigorous examination of the data is not possible as the weight-frequency distribution of the sampler results is bimodal. The frequency distribution of the frame data is almost normal. This difference is not an indication of the inadequacy of either method; it shows that the methods yield different information. Despite extensive use of the 1-cm² sampler, no other bimodal distributions were encountered. All others were unimodal and estimates of scatter were calculated in the usual way.

DISAPPEARANCE OF LEAF LITTER IN OAK WOODLAND

In plot 1 the progressive month-by-month changes in oven-dry weight of recently fallen litter was followed using the 1-cm² sampler. From December, 1955 to July, 1957, a monthly sampling, each consisting of 65 units, was taken at random points within the area and treated as described above.

In 1955, after leaf fall, there was a progressive fall in weight of litter per unit area (*Figure 103*). The data were tested against a hypothesis of linearity and as this was not contradicted a regression was fitted using the method of least squares. This gives $y = 0{\cdot}15742 - 0{\cdot}001578x$, where y represents the weight of litter (g/cm²), and x, the number of months forward in time from May, 1956. The two conditions necessary for the use of the least-squares method, homogeneity of variance (Bartlett's test) and random sampling, were satisfied.

The results following leaf fall in 1956 were less consistent. The inconsistencies are probably due to the difficulty of distinguishing accurately one year's litter from another after the most recently fallen material has been on the ground for a few months, a difficulty which is experienced whatever sampling-unit size is used. The dampness of the litter seems to affect markedly the evaluation of litter age. In passing, it is noteworthy that this difficulty is heightened in mixed woodland where different leaves are decomposing at different rates.

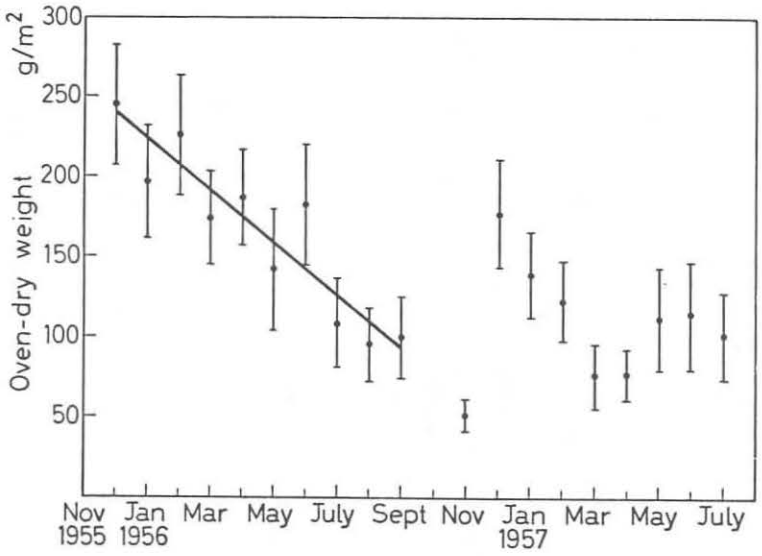

Figure 103. Monthly mean weights (●) 95 per cent confidence limits (**I**) of recently fallen litter in a mature oak-wood (*Quercus petraea* Liebl.) over 20 months, and a regression line for the period December, 1955 to September, 1956

In order to avoid the errors inherent in evaluation of litter age, estimates were obtained of the weight of the combined L and F humus layers, and the H layer of plot 1, the former in the spring and autumn of 1956, the latter in the autumn only (*Table 73*). The H layer had a high mineral content with a mean loss on ignition of 39·9 per cent.

Table 73. Weight of humus layers and loss on ignition in mature oak-wood (mean oven-dry weight ± S.E., and loss on ignition ± S.E.; 65 sampling units (1 cm²/unit; plot 1) per sampling)

Time of sampling	Combined L and F layers (kg/m²)	Mean loss on ignition (per cent)	H layer (kg/m²)	Mean loss on ignition (per cent)
Spring, 1956	2·3 ± 0·1	84·9 ± 1·4	—	—
Autumn, 1956	2·1 ± 0·1	84·4 ± 1·4	4·4 ± 0·4*	39·9 ± 1·8

* 64 sampling units.

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